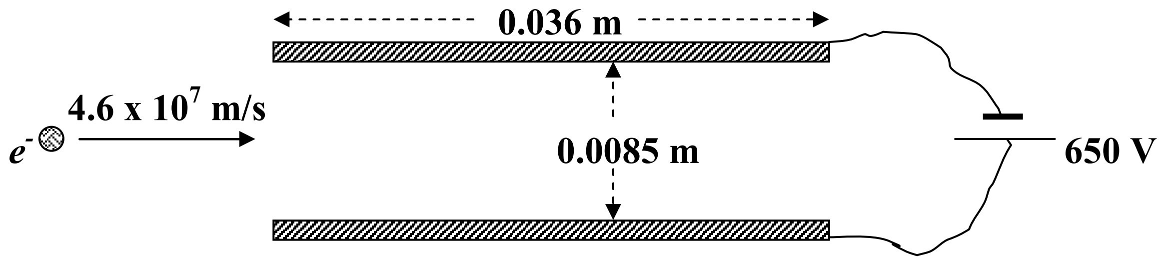
Example 15. An electron travelling at 4.6×10^7 m/s enters a constant electric field between two charged plates spread 0.0085 m apart, as shown below. The voltage between the plates is 650 V and the plates are 0.036 m long.



a) What is the electric force acting on the electron?
b) How much time is taken for the electron to pass through the plates?
c) How far will the electron "fall" from its path while in-between the two plates?

Hint: for b) and c), you'll have to examine horizontal and vertical components, just like for objects fired horizontally off a cliff.

a) $F_E = qE$ and $E = \frac{\Delta V}{d}$ between the plates

so $F_E = q\frac{\Delta V}{d}$

$= \frac{(1.6 \times 10^{-19})(650)}{.0085}$

$= 1.22 \times 10^{-14}$ N

b) speed is constant "horizontally" because F_E acts ⊥ to motion

∴ $d = v_{av} t$ $\quad t = \frac{.036}{4.6 \times 10^7}$

$t = 7.83 \times 10^{-10}$ s

c) → find "vertical" acceleration:

$$F_{Net} = F_E = ma$$

$$a = \frac{1.22 \times 10^{-14}}{9.11 \times 10^{-31}} = 1.34 \times 10^{16}\ m/s^2$$

→ also in the vertical direction:

$$V_o = 0$$

$$t = 7.83 \times 10^{-10}\ s$$ → time in plates where electron "falls"

$$d = \cancel{v_o t} + \frac{1}{2}at^2$$

$$= \frac{1}{2}(1.34 \times 10^{16})(7.83 \times 10^{-10})^2$$

$$\boxed{d = 4.1 \times 10^{-3}\ m}$$